



UNITED STATES PATENT AND TRADEMARK OFFICE

Over
UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,199	02/09/2004	Kia Silverbrook	MTB18US	8280
24011	7590	08/22/2006		EXAMINER
SILVERBROOK RESEARCH PTY LTD 393 DARLING STREET BALMAIN, NSW 2041 AUSTRALIA				CHOI, HAN S
			ART UNIT	PAPER NUMBER
				2853

DATE MAILED: 08/22/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/773,199	SILVERBROOK, KIA	
	Examiner	Art Unit	
	Han S. Choi	2853	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on 19 June 2006.
 2a) This action is **FINAL**. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1-54 is/are pending in the application.
 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 1-54 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on 09 February 2004 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) <input type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____.
3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>6/19/06</u> .	5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)
	6) <input type="checkbox"/> Other: _____.

DETAILED ACTION

Terminal Disclaimer

1. The terminal disclaimer filed on 6/19/06 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of USSN 10/773183 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Response to Arguments

2. Applicant's arguments filed 6/19/06 have been fully considered but they are not persuasive. Applicant's arguments do not address the limitations of the claims.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1, 4, 12, 19, 22, and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over lms (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104).

Referring to claims 1, 12, 19, and 31, lms discloses the basic elements of the claimed invention. lms teaches an ink jet printhead [10] in [Col. 4, Line 48] shown in Fig. 1. and a printer system in [Col. 4, Lines 7-9]. lms teaches a plurality of nozzles in

[Col. 8, Lines 44-45]. Ims teaches a heater associated with each of the nozzles respectively in [Col. 8, Lines 6-11] and the heater having at least one heater element configured for thermal contact with a bubble forming liquid; such that, heating the heater element above the boiling point of the bubble forming liquid forms a gas bubble that ejects a drop of ejectable liquid from the nozzle in [Col. 5, Lines 39-50]. Ims does not teach the gas bubble subsequently collapsing to a point of collapse that is spaced from any solid surface of the heater elements or the bubble forming chamber.

Keil et al. teaches a bubble collapse occurring at a location well spaced from the heat transducer [34] in [Col. 4, Lines 48-56] shown in Figs. 3-5.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Keil et al. with the printhead of Ims for the purpose of extending the life of the heat transducer [34].

Referring to claims 4 and 22, Ims teaches the gas bubble encircles at least some of the heater element in [Col. 5, Lines 44-51]. (“bubble or water vapor thermally isolates the ink from the heating element” means that bubble is surrounding the heating element.)

5. Claims 2, 3, 8, 13, 20, 21, 27, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Silverbrook (US Pat. 5,841,452).

lms in view of Keil et al. disclose the basic elements of the claimed invention except for the heater elements and bubble forming chamber being symmetrical about a longitudinal plane, the bubble forming chamber having a circular cross section wherein the heater element has at least one arcuate section that is concentric with the longitudinal axis of the bubble forming chamber; such that during use, the arcuate section forms a disc-shaped bubble with a point of collapse substantially on the central axis of the bubble forming chamber, the heater element configured such that an actuation energy of less than 500 nanojoules is required to heat the heater element sufficiently to form a bubble to cause the ejection of a drop, and except for a structure incorporating nozzles formed by chemical vapor deposition (CVD).

Silverbrook teaches the heater element [440] and bubble forming [447] chamber being symmetrical about a longitudinal plane in [Col. 8, Lines 48-49] shown in Fig. 13 (the heater element [440] and the bubble forming chamber [447] are concentric with each other, therefore symmetrical about any longitudinal plane). Silverbrook teaches the heater element having at least one arcuate section (the curved segment of [441 and 443]) that is concentric with the longitudinal axis of the bubble forming chamber in [Col. 8, Lines 48-49], the bubble forming chamber [447] having a circular cross section in Fig. 13, and the arcuate section [441 and 443] forming a disc-shaped bubble with a point of collapse substantially on the central axis of the bubble forming chamber [447] in [Col. 8, Lines 42-50] shown in Fig. 13 (the annular ink vapour bubble of [Col. 8, Line 50] will collapse substantially on the central axis of the bubble forming chamber as an insulation layer [132] which is concentric with the bubble forming chamber protects the heater

[120] from a collapsing vapour bubble in [Col. 7, Lines 6-11] in Fig. 12). Silverbrook teaches that typically 200 nanojoules is required to eject a drop by heating the heater element in [Col. 18, Lines 15-18]. Silverbrook teaches a thick chemical vapor deposition (CVD) glass over coat [142] which forms the nozzle region in [Col. 9, Lines 57-58] shown in Fig. 12.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the heater and bubble forming chamber structure, the requirement of applying a typical heating energy of 200 nanojoules, and a nozzle plate formed by chemical vapor deposition (CVD) of Silverbrook to the heating element and printhead of Ims in view of Keil et al. for the purpose of producing annular ink vapour bubbles that exerts near equal pressure to all sides of the ink drop [446] in [Col. 8, Lines 48-52], maintaining print speed while reducing power dissipation, and to provide mechanical strength to resist the shock of exploding or collapsing vapor bubbles and to provide protection against the external environment in [Col. 8, Lines 22-25].

6. Claims 5 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Dunn (US Pat. 4,982,199).

Ims in view of Keil et al. disclose the basic elements of the claimed invention except for the bubble forming liquid and the ejectable liquid being a common body of liquid.

Dunn teaches the bubble forming liquid and the ejectable liquid common to each other in [Col. 2, Lines 31-38] (the bubble is created from the same ink as the ink that is ejected).

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Dunn with the printhead of Ims in view of Keil et al. for the purpose of heating the same ink with a heater to create a bubble to cause the ejection of ink.

7. Claims 6, 7, 11, 18, 23, 25, 26, 30, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Keil et al. disclose the basic elements of the claimed invention except for a page-width printhead configuration, the heater element in the form of a cantilever beam, the heater element having two opposite sides and configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element, supporting the bubble forming liquid in thermal contact with each heater element and ejectable liquid adjacent each nozzle, and the heater element substantially covered by a conformal protective coating, all sides of the coating being seamless.

Kubby teaches the printhead extending across the entire width of the sheet. Kubby teaches the heater element in the form of a suspended or cantilever beam [18] in [Col. 3, Lines 53-55]. Kubby teaches the heater element [20a and 20b] causing a gas

bubble to be formed on both sides of the heater element [20a or 20b] in [Col. 4, Lines 59-63]. Kubby teaches a configuration to support the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle in [Col. 3, Lines 13-24] shown in Fig. 2. Kubby teaches a heater element [20a or 20b] that is substantially covered by a protective coating substantially to all sides, which are seamless in [Col. 4, Lines 32-50] shown in Fig. 4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the elements taught by Kubby to the printhead of Ims in view of Keil et al. for the purpose of placing an image on a sheet in a single pass, exposing both sides of the heater for vaporizing liquid ink, ejecting a sufficient amount of ink from the ejector, properly heating the ink, and protecting the heater.

8. Claims 9 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Silverbrook (US Pat. 5,856,836).

Ims in view of Keil et al. discloses the basic elements of the claimed invention except for the printhead configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied to heat the heater element to cause ejection of an ink drop is less than the energy required to heat a volume of an ejectable liquid equal to the volume of the ink drop, from an ambient temperature to the boiling point.

Silverbrook ('836) teaches in [Col. 4, Lines 59-65] comprising a thermally activated liquid ink printing head being characterized by the energy required to eject a drop of ink being less than the energy required to raise the temperature of the received supply of ink of a volume equal to the volume of said ink drop above the ambient ink temperature to below ejection temperature. Ejection temperature is referred to in Claims 1 and 19 as the temperature above boiling point. Therefore, "below ejection temperature" would include the boiling point.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Silverbrook with the printhead of Ims in view of Keil et al. for the purpose of providing a higher nozzle density per row, a manufacturing process for the printhead with low production costs, and to dissipate the full amount of the active power in the printed ink itself.

9. Claims 10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Feinn et al. (US Pat. 6,543,879).

Ims in view of Keil et al. discloses the basic elements of the claimed invention except for a nozzle density greater than 10000 nozzles/cm².

Feinn et al. teaches in [Col. 2, Lines 1-14] a nozzle packing density of at least 100 nozzles/mm², which is equal to 10000 nozzles/cm² when converted to square centimeters.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the nozzle density of Feinn et al. to the printhead of lms in view of Keil et al. for the purpose of accommodating higher printing resolutions and to improve the printhead drop generation rate in [Col. 1, Lines 57-61].

10. Claims 14 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over lms (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Kashino et al. (US Pat. 5,534,898).

lms in view of Keil et al. discloses the basic elements of the claimed invention except for a nozzle plate of the printhead having a thickness of less than 10 microns.

Kashino et al. teaches a thickness of an orifice plate in the order of several microns in [Col. 6, Lines 34-41].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the thickness of the Kashino et al. nozzle plate to the lms in view of Keil et al. printhead for the purpose of obtaining adequate values of the velocity of the discharged ink droplets, amount of ink droplet and refilling frequency, and in consideration of the distance between the thermal energy generating element and the discharge port.

11. Claims 15 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over lms (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Komuro (US Pat. 4,965,594).

Ims in view of Keil et al. discloses the basic elements of the claimed invention except for a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

Komuro teaches heating resistors [11A, 21, and 31] of a first, second, and third layer formed on different respective layers and a plurality of nozzles [2] having chambers [4] with heaters [11A, 21, and 31] disposed within in [Cols. 3 and 4, Lines 25-68 and 1-34] shown in Figs. 1-4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the stated structure of Komuro with the printhead of Ims in view of Keil et al. for the purpose of keeping discharge speed and frequency characteristics in a stable manner.

12. Claims 16 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Chan (US Pat. 5,710,070).

Ims in view of Keil et al. disclose the basic elements of the claimed invention except for a heater element formed of solid material of which more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

Chan teaches a thermal inkjet printhead comprising a resistive layer composed of titanium nitride, which forms a resistor and a contact metal barrier layer in [Col. 2, Lines 10-14]. Titanium has an atomic number less than 50 on the periodic table.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the titanium nitride resistor to the printhead of Ims in view of Keil et al. for the purpose of having resistors that are more reliable, especially at higher temperatures and less complicated to manufacture.

13. Claims 17 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) as applied to claims 1 and 19 above, and further in view of Pan et al. (US Pat. 4,931,813).

Ims in view of Keil et al. discloses the basic elements of the claimed invention except for the heater element configured to a mass of less than 10 nanograms. Pan et al. discloses the heater element including a solid that is heated to form a bubble vapor to cause ejection of an ink drop, but does not explicitly teach the solid having a mass less than 10 nanograms. It would have been obvious at the time the invention was made to a person having ordinary skill in the art at the time the invention was made to apply at least 10 nanograms of the solid material to the heating element of Ims in view of Keil et al. to cause an ejection of an ink drop since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ (CCPA 1980.)

14. Claims 38, 41, and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191).

Referring to claims 38 and 48, Ims discloses the basic elements of the claimed invention. Ims teaches an ink jet printhead [10] in [Col. 4, Line 48] shown in Fig. 1. and a printer system in [Col. 4, Lines 7-9]. Ims teaches a plurality of nozzles in [Col. 8, Lines 44-45]. Ims teaches a heater associated with each of the nozzles respectively in [Col. 8, Lines 6-11] and the heater having at least one heater element configured for thermal contact with a bubble forming liquid; such that, heating the heater element above the boiling point of the bubble forming liquid forms a gas bubble that ejects a drop of ejectable liquid from the nozzle in [Col. 5, Lines 39-50]. Ims does not teach the gas bubble subsequently collapsing to a point of collapse that is spaced from any solid surface of the heater elements or the bubble forming chamber. Ims does not teach supplying the nozzle with a replacement volume of the ejectable liquid equivalent to the ejected drop.

Keil et al. teaches a bubble collapse occurring at a location well spaced from the heat transducer [34] in [Col. 4, Lines 48-56] shown in Figs. 3-5.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Keil et al. with the printhead of Ims for the purpose of extending the life of the heat transducer [34].

Fukuchi et al. teaches replacing an amount equal in volume to the ink that was ejected from the nozzles in [Col. 1, Lines 35-38].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Fukuchi et al. with the modified printhead of Ims for the purpose of preventing ink degeneration in the pressure chamber in [Col. 3, Lines 51-58].

Referring to claim 41, Ims teaches the gas bubble encircles at least some of the heater element in [Col. 5, Lines 44-51]. (“bubble or water vapor thermally isolates the ink from the heating element” means that bubble is surrounding the heating element.)

15. Claims 39, 40, 44, and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Silverbrook (US Pat. 5,841,452).

Ims in view of Keil et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for the heater elements and bubble forming chamber being symmetrical about a longitudinal plane, the bubble forming chamber having a circular cross section wherein the heater element has at least one arcuate section that is concentric with the longitudinal axis of the bubble forming chamber; such that during use, the arcuate section forms a disc-shaped bubble with a point of collapse substantially on the central axis of the bubble forming chamber, the heater element configured such that an actuation energy of less than 500 nanojoules is required to heat the heater element sufficiently to form a bubble to cause the ejection of a drop, and

except for a structure incorporating nozzles formed by chemical vapor deposition (CVD).

Silverbrook teaches the heater element [440] and bubble forming [447] chamber being symmetrical about a longitudinal plane in [Col. 8, Lines 48-49] shown in Fig. 13 (the heater element [440] and the bubble forming chamber [447] are concentric with each other, therefore symmetrical about any longitudinal plane). Silverbrook teaches the heater element having at least one arcuate section (the curved segment of [441 and 443]) that is concentric with the longitudinal axis of the bubble forming chamber in [Col. 8, Lines 48-49], the bubble forming chamber [447] having a circular cross section in Fig. 13, and the arcuate section [441 and 443] forming a disc-shaped bubble with a point of collapse substantially on the central axis of the bubble forming chamber [447] in [Col. 8, Lines 42-50] shown in Fig. 13 (the annular ink vapour bubble of [Col. 8, Line 50] will collapse substantially on the central axis of the bubble forming chamber as an insulation layer [132] which is concentric with the bubble forming chamber protects the heater [120] from a collapsing vapour bubble in [Col. 7, Lines 6-11] in Fig. 12). Silverbrook teaches that typically 200 nanojoules is required to eject a drop by heating the heater element in [Col. 18, Lines 15-18]. Silverbrook teaches a thick chemical vapor deposition (CVD) glass over coat [142] which forms the nozzle region in [Col. 9, Lines 57-58] shown in Fig. 12.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the heater and bubble forming chamber structure, the requirement of applying a typical heating energy of 200 nanojoules, and a

nozzle plate formed by chemical vapor deposition (CVD) of Silverbrook to the heating element and printhead of Ims in view of Keil et al. and Fukuchi et al. for the purpose of producing annular ink vapour bubbles that exerts near equal pressure to all sides of the ink drop [446] in [Col. 8, Lines 48-52], maintaining print speed while reducing power dissipation, and to provide mechanical strength to resist the shock of exploding or collapsing vapor bubbles and to provide protection against the external environment in [Col. 8, Lines 22-25].

16. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Dunn (US Pat. 4,982,199).

Ims in view of Keil et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for the bubble forming liquid and the ejectable liquid being a common body of liquid.

Dunn teaches the bubble forming liquid and the ejectable liquid common to each other in [Col. 2, Lines 31-38] (the bubble is created from the same ink as the ink that is ejected).

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teachings of Dunn with the printhead of Ims in view of Keil et al. and Fukuchi et al. for the purpose of heating the same ink with a heater to create a bubble to cause the ejection of ink.

17. Claims 43, 47, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Kubby (US Pat. 5,706,041).

Ims in view of Keil et al. and Fukuchi et al. discloses the basic elements of the claimed invention except for a page-width printhead configuration, the heater element having two opposite sides and configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element, and the heater element substantially covered by a conformal protective coating, all sides of the coating being seamless.

Kubby teaches the printhead extending across the entire width of the sheet. Kubby teaches the heater element [20a and 20b] causing a gas bubble to be formed on both sides of the heater element [20a or 20b] in [Col. 4, Lines 59-63]. Kubby teaches a heater element [20a or 20b] that is substantially covered by a protective coating substantially to all sides, which are seamless in [Col. 4, Lines 32-50] shown in Fig. 4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the elements taught by Kubby to the printhead of Ims in view of Keil et al. and Fukuchi et al. for the purpose of placing an image on a sheet in a single pass, properly heating the ink, and protecting the heater.

18. Claim 45 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Silverbrook (US Pat. 5,856,836).

Ims in view of Keil et al. and Fukuchi et al. discloses the basic elements of the claimed invention except for the printhead configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied to heat the heater element to cause ejection of an ink drop is less than the energy required to heat a volume of an ejectable liquid equal to the volume of the ink drop, from an ambient temperature to the boiling point.

Silverbrook ('836) teaches in [Col. 4, Lines 59-65] comprising a thermally activated liquid ink printing head being characterized by the energy required to eject a drop of ink being less than the energy required to raise the temperature of the received supply of ink of a volume equal to the volume of said ink drop above the ambient ink temperature to below ejection temperature. Ejection temperature is referred to in Claim 38 as the temperature above boiling point. Therefore, "below ejection temperature" would include the boiling point.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the teaching of Silverbrook with the printhead of Ims in view of Keil et al. and Fukuchi et al. for the purpose of providing a higher nozzle density per row, a manufacturing process for the printhead with low

production costs, and to dissipate the full amount of the active power in the printed ink itself.

19. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Feinn et al. (US Pat. 6,543,879).

Ims in view of Keil et al. and Fukuchi et al. discloses the basic elements of the claimed invention except for a nozzle density greater than 10000 nozzles/cm².

Feinn et al. teaches in [Col. 2, Lines 1-14] a nozzle packing density of at least 100 nozzles/mm², which is equal to 10000 nozzles/cm² when converted to square centimeters.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the nozzle density of Feinn et al. to the printhead of Ims in view of Keil et al. and Fukuchi et al. for the purpose of accommodating higher printing resolutions and to improve the printhead drop generation rate in [Col. 1, Lines 57-61].

20. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Kashino et al. (US Pat. 5,534,898).

Ims in view of Keil et al. and Fukuchi et al. discloses the basic elements of the claimed invention except for a nozzle plate of the printhead having a thickness of less than 10 microns.

Kashino et al. teaches a thickness of an orifice plate in the order of several microns in [Col. 6, Lines 34-41].

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the thickness of the Kashino et al. nozzle plate to the Ims in view of Keil et al. and Fukuchi et al. printhead for the purpose of obtaining adequate values of the velocity of the discharged ink droplets, amount of ink droplet and refilling frequency, and in consideration of the distance between the thermal energy generating element and the discharge port.

21. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Komuro (US Pat. 4,965,594).

Ims in view of Keil et al. and Fukuchi et al. discloses the basic elements of the claimed invention except for a plurality of nozzle chambers each corresponding to a respective nozzle, and a plurality of said heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers to one another.

Komuro teaches heating resistors [11A, 21, and 31] of a first, second, and third layer formed on different respective layers and a plurality of nozzles [2] having chambers [4] with heaters [11A, 21, and 31] disposed within in [Cols. 3 and 4, Lines 25-68 and 1-34] shown in Figs. 1-4.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the stated structure of Komuro with the printhead of lms in view of Keil et al. and Fukuchi et al. for the purpose of keeping discharge speed and frequency characteristics in a stable manner.

22. Claim 52 is rejected under 35 U.S.C. 103(a) as being unpatentable over lms (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Chan (US Pat. 5,710,070).

lms in view of Keil et al. and Fukuchi et al. disclose the basic elements of the claimed invention except for a heater element formed of solid material of which more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

Chan teaches a thermal inkjet printhead comprising a resistive layer composed of titanium nitride, which forms a resistor and a contact metal barrier layer in [Col. 2, Lines 10-14]. Titanium has an atomic number less than 50 on the periodic table.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to incorporate the titanium nitride resistor to the printhead

of Ims in view of Keil et al. and Fukuchi et al. for the purpose of having resistors that are more reliable, especially at higher temperatures and less complicated to manufacture.

23. Claim 53 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ims (US Pat. 4,797,692) in view of Keil et al. (US Pat. 6,447,104) and Fukuchi et al. (US Pat. 4,549,191) as applied to claim 38 above, and further in view of Pan et al. (US Pat. 4,931,813).

Ims in view of Keil et al. and Fukuchi et al. discloses the basic elements of the claimed invention except for the heater element configured to a mass of less than 10 nanograms.

Pan et al. discloses the heater element including a solid that is heated to form a bubble vapor to cause ejection of an ink drop, but does not explicitly teach the solid having a mass less than 10 nanograms. It would have been obvious at the time the invention was made to a person having ordinary skill in the art at the time the invention was made to apply at least 10 nanograms of the solid material to the heating element of Ims in view of Keil et al. and Fukuchi et al. to cause an ejection of an ink drop since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ (CCPA 1980.)

Conclusion

3. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Han S. Choi whose telephone number is (571) 272-8350. The examiner can normally be reached on Monday - Friday, 8:30am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

HSC
8/11/06



STEPHEN MEIER
SUPERVISORY PATENT EXAMINER